LE-300 Turbine

Installation & Operation Guide

1m Diameter Micro Wind Turbine for generating clean and renewable electricity anywhere the wind blows…

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Warranty Registration

Please register your product with us so that we can administer your warranty entitlement.

Please register at ***www.leturbines.com/support/warranty-registration/***

Customers are required to keep an original copy of their invoice should questions arise requiring reference to purchase information.

Read this first

1. **Don't connect the wind turbine in the wrong polarity**
   Make sure you connect the +ve of the turbine to the +ve of the battery (red to red) and the -ve of the turbine to the -ve of the battery (black to black). Failing to do so will damage the equipment and invalidate your warranty.

2. **Don't connect the Diversion Charge Controller in series with the turbine**
   Always ensure that the turbine and the controller are connected to the battery separately.

3. **Ensure the blades are fitted in the correct orientation**
   Consult the diagram on page 9. Blades fitted back to front it will severely impair power production.

4. **Don't allow the turbine to run without being connected to the battery**
   Failing to do so will result in the turbine freewheeling causing premature wear and tear and unnatural blade noise.

Introduction

Please read this manual thoroughly before attempting to assemble, install or operate your *LE-300* small wind turbine. This will assure optimum performance and safety.

Leading Edge Turbines has spent many years developing the ideas and technology behind your turbine. The *LE-300* features an array of innovations and construction techniques as well as heavy-duty engineering to ensure optimum efficiency and a long operating life.

The *LE-300* has been designed to be simple, economic, durable and yield excellent performance.

Specific *LE-300* turbine features:

- Innovatively designed axial flux alternator, using neodymium iron boron magnets
- A laser-cut aluminium chassis using 'Yaw-wing' design to ensure responsive yawing and to reduce weight
- Maintenance-free, low friction bearing in both main shaft and yaw assemblies
- Extremely quiet injection moulded blades with 'Whispower' geometry and aerofoil design
- Long-life yaw pivot slip-rings and wipers
- Easy tower-top installation
- Simple design for low cost and durability
- Fully marinised using stainless steel fixings and anodised aluminium components
- Low mass to help reduce exerted forces and ensure easy installation.

The *LE-300* has been designed for both land-based and marine environments. Thanks to its unique design, the *LE-300* will minimise corrosion in both normal and salt water operating conditions.

Applications include:

- Sailboats, yachts
- Remote homes / caravans
- Street lighting and road signage
- Complementary installation with photovoltaic modules for home power
- Farm utilities (electric fencing, irrigation, etc.)
- Wind-electric water pumping
- Cathodic protection
- Monitoring sites
- Telecommunications
- The Developing World.

Safety Precautions

Safety must always be your primary concern during the assembly, installation and operation of your *LE-300* turbine. Always be aware of the risks involved with mechanical and electrical installation work. If in doubt about any issue regarding your turbine, please seek further assistance before proceeding. Installation of the *LE-300* turbine should only be undertaken by suitably competent and qualified personnel.

Mechanical Safety Hazards

- The main rotor is the most obvious and serious mechanical safety risk. When the turbine is operating at its rated performance, the blades will be very difficult to see, due to the speed of rotation. Never approach the turbine whilst it is operating. Always shut down the turbine by activating the stop switch. **Ensure that the turbine is installed in a suitable position where nobody can approach or interfere with the path of the rotor blades.**
- Working with tools of any kind can be dangerous. Your *LE-300* turbine requires some basic mechanical assembly with rudimentary hand tools. If you are in any doubt about how to use these tools correctly, please seek advice from a suitably experienced person.
- Your *LE-300* turbine will inevitably be installed upon a tower or other support mount. This may mean working at height. Always ensure that all personnel in the immediate vicinity are aware of any lifting / hoisting operations that will be occurring. Check there are no loose components or tools likely to fall and cause injury during the lifting operation. Where possible, all assembly work should be completed at ground level. In the case of roof mount brackets, a suitable fitter should carry out the installation with the appropriate equipment for working at height.
- Ensure that the batteries are disconnected during the installation procedure.
- Twist the turbine output cables together (to create a short circuit) during the mechanical installation process. This will prevent the turbine from 'spinning up' during the installation.
- Never install the turbine upside down or in any orientation other than that depicted on the installation instructions.
- Install your turbine during a calm day.
- When performing routine inspection or maintenance, always stop the turbine by activating the stop switch.

Electrical Safety Hazards

- The *LE-300* generates rectified DC voltage. Even at these low voltages there are inherent risks. Caution should always be used when connecting the *LE-300* to the electrical system.
- Be sure that you have followed the cable-sizing chart to ensure that the correct size of transmission cable has been selected. If a cable of insufficient cross-sectional area is used, heat may build up in the cables causing a potential fire hazard. A properly sized fuse or circuit breaker should be used in the cables connected to the battery. This will stop the risk of short circuit currents. Using cables of insufficient cross-sectional area may also reduce the power transmission efficiency of the turbine.
- Battery systems can deliver a serious amount of current. A short circuit in the battery circuit can lead to hundreds of amps flowing through the battery cables. This will cause a heat build-up and ultimately an electrical fire. Batteries can explode when shorted. Always use insulated electrical tools when working on the battery's electrical connections.
- Batteries are very heavy. Do not attempt to move batteries by yourself. Always use manual handling tools and an assistant.
- Always keep lead-acid batteries the correct way up. Do not allow the acidic electrolyte to spill or come into contact with your skin or face. Always follow the manufacturer's safety instructions when handling lead-acid batteries.
- Never run the *LE-300* 'off-load' with the output cables not connected to anything.

Please use common sense when installing and operating your turbine!

Specifications

Turbine Name: *LE-300*
Part Number: GA-LETU-007
Nominal Voltage: 12V / 24V / 48V DC or Grid-tie optimised

Rotor Diameter: 1000 mm
Rated Wind Velocity: 8 m/s
Rated Output: 85 Watts
Max Output: 300 Watts
Rated RPM: 800
Start-up Wind Velocity: 2 m/s
Total weight: 6.5 Kg
Tower mount: 48.3 mm / 50 mm Outer Diameter Tube
Chassis Construction: Aluminium
Rotor Blades (3-off): Glass Reinforced Nylon

Fig-1: Diametric View

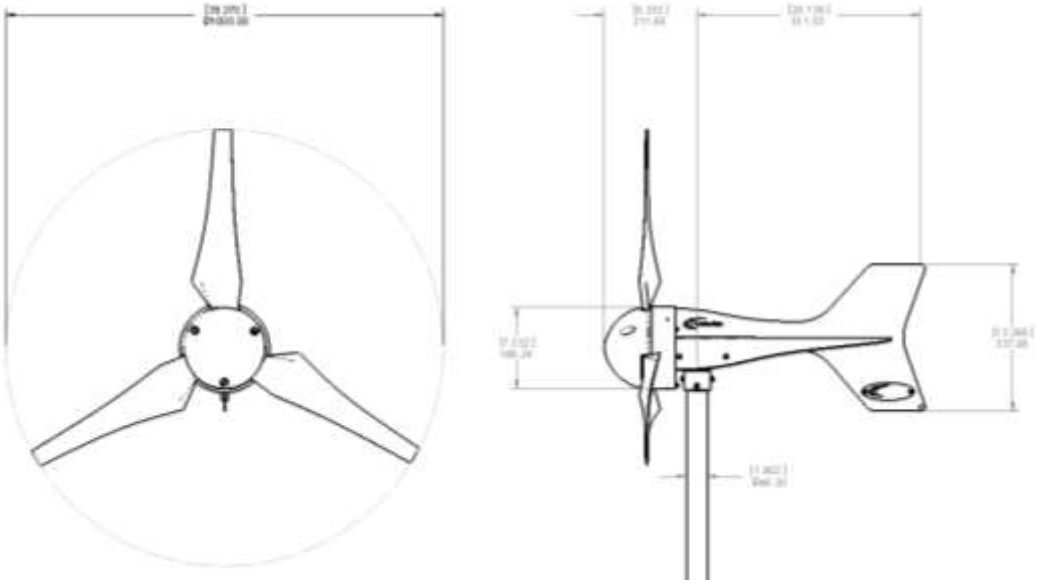

Fig-2: Operating Envelope

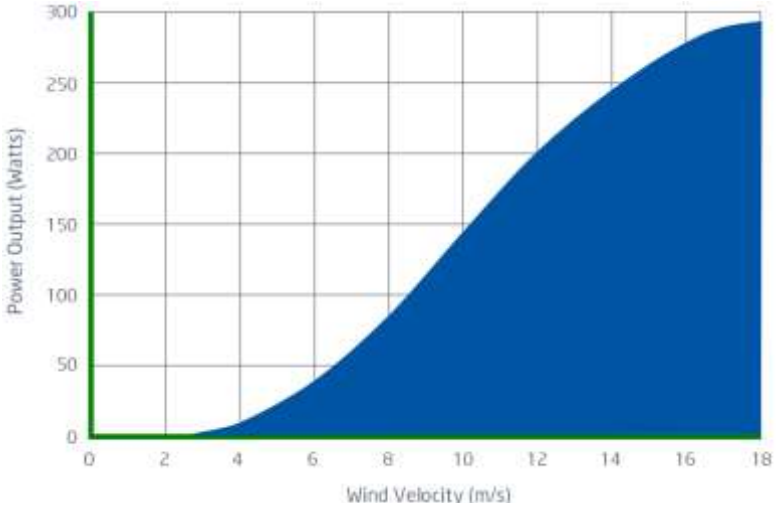

Fig-3: Energy Conversion

Package Contents

Your *LE-300* turbine will arrive containing the components shown below. If any of the items are missing or damaged, please contact your dealer immediately.

LE-300 Chassis: Qty 1

Rotor Blade: Qty 3

Hub Plate: Qty 1

Nose Cone: Qty 1

User Manual: Qty 1

9 x	M6 x16 Cap Heads
11 x	M6 Nuts & Washers
23 x	M6 Washers
2 x	M6 x 65 Bolts
3 x	M5 x 12 Cap Heads
3 x	M5 x 20 Cap Heads
1 x	Yaw mount shim

Fixings Bag: Qty 1

Tools Required For Assembly

You will require the following tools to assemble your *LE-300* turbine:

- 10 mm A/F spanner & 10 mm ratchet (one of each required)
- 8 mm A/F spanner or ratchet
- A set of Metric Standard Hexagon Keys
- Electrical screw drivers
- Power drill
- 6.5 mm diameter twist drill bit, suitable for drilling through steel
- Digital multi-meter capable of measuring DC Volts
- Tape measure or steel rule
- Thread locking compound e.g. Loctite.
- Protective Gloves

Mechanical Assembly Procedure

1) ***Unpacking -*** Inspect the contents of the box and ensure that all items are present and undamaged. If any of the components are missing or damaged, please contact your dealer immediately.
2) ***Check Magnet Rotor & Continuity -*** Ensure that the main shaft is free turning and does not scrape or rub as it rotates - see Fig 4. You may feel a slight resistance from the bearings at this stage. The bearing units used in the magnet rotor assembly are factory lubricated and sealed for life. It will take approximately 100 hours of normal operation for the seals to 'bed-in' and the lubrication to be distributed correctly around the bearing raceways and ball cages. During this period you may notice a reduced performance caused by the additional friction of the bearing seals. In operating temperatures of –10 degrees Centigrade or lower, this 'bedding-in' period will be extended by a further 50 hours of normal operation. Connect a digital multi-meter to the positive (red) and negative (black) output leads extending from the yaw pivot. With the multi-meter set to detect DC Volts (0-20V approx), a voltage should be displayed when the magnet rotor is spun. This voltage will vary with the speed of rotation. If the magnet rotor rubs, or no voltage is detected whilst turning the magnet rotor, please contact your dealer immediately.

Warning: The magnet rotor within your *LE-300* turbine is constructed using neodymium iron boron rare earth magnets. These are extremely powerful magnets and can cause injury if not handled with respect. Take care when working with tools made of ferrous materials (such as spanners and screwdrivers) close to the *LE-300* alternator. The magnetic forces between ferrous materials and the magnet rotor within the alternator maybe very strong. This may cause a sudden snapping action that can pinch or trap your fingers or skin.

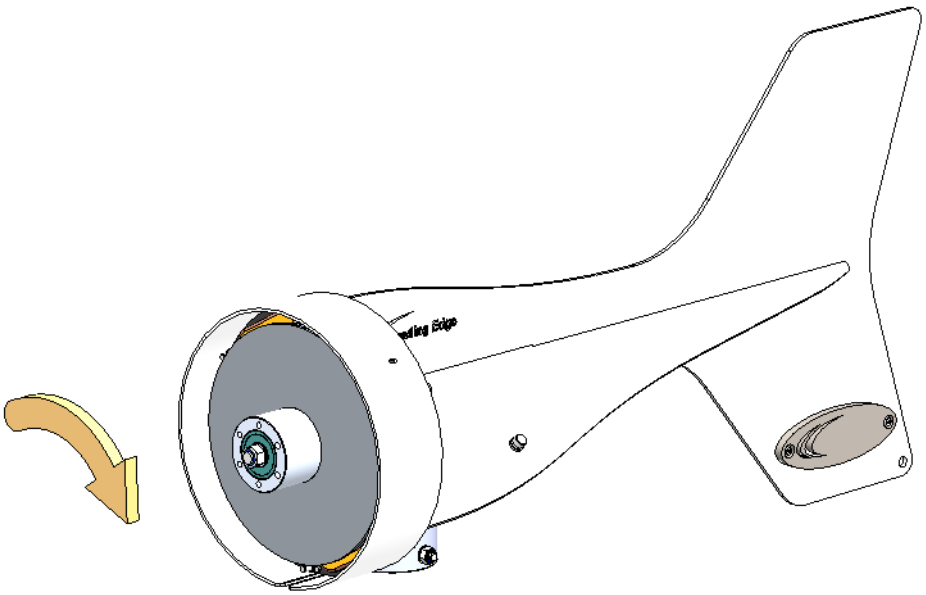

Fig-4: Checking magnet rotor rotation and coil-disc continuity

3) ***Rotor Blade Assembly -*** Take the three rotor blades and rotor hub plate. Be careful when handling the blades, they may have sharp edges. Use a 10 mm A/F socket & hexagon key and three M6 x 16 mm long cap screws to attach each blade to the hub plate - see Fig-5. Ensure that the cap head end of the screw is on the rotor hub plate side (thus allowing the washers and nuts to locate inside of the blades). The blades should all be fixed to the hub plate on the same side, with the blades in the same orientation. It is important that a washer is used underneath the anti-vibration nuts. Three set-screws, three washers and three anti-vibration nuts should be used on each blade. Tighten the fixings until the blades are safely secured. Do not over-tighten the nuts as this may damage the blades and fixings.

Fig-5: Attaching the 3 rotor blades to the hub plate

4) ***Check the Tip Spacing -*** Although the turbine blades are fitted with location 'keyways', it is important to check the tip spacing. Lay the assembled rotor blade on a flat surface. Using a tape measure or long steel rule, ensure that the spacing between each tip is equal to within a tolerance of +/-1.5 mm. Adjust the blades as required. Output performance may suffer if the blades are inaccurately set - see Fig-6.

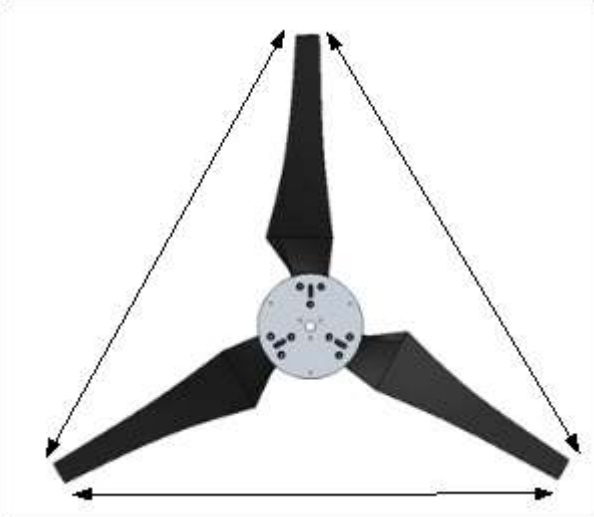

Fig-6: Checking tip spacing

5) ***Fit the Rotor Blade Assembly -*** The assembled rotor blades can now be fitted to the *LE-300* chassis. This is done by offering the rotor hub plate against the drive shaft protruding from the front of the chassis. M5 x 20 long cap head screws should then be used to fix the rotor hub in position using the three unused tapped holes in the drive shaft. Ensure that all three screws are securely tightened and that the rotor blades are fitted with the flat side of the blade facing forwards. Thread-locking compound should be used on the screw threads.

Fig-7: Fitting the rotor blades to the chassis

6) ***Check the Blade Rotation -*** Once the blades have been fitted and secured to the chassis, ensure that they rotate freely. Take this opportunity to check that all of the blade and hub fixings are secure - see Fig-8.

Fig-8: Check blade rotation

7) ***Fit the Nose Cone -*** The nose cone can now be fitted to the rotor. This is done by aligning the three mounting holes of the nose cone with those on the rotor hub plate. Use three M5 x 12 long screws to secure the nose cone in position - see Fig-9.

Fig-9: Attach the nose cone

8) ***Prepare the Turbine Mount -*** If you have purchased a *LE-300* mount bracket or tower from a *Leading Edge Turbines'* dealer, then please refer to the separate installation instructions supplied with the product. If you have sourced your own tower / mount bracket, 6.5 mm diameter holes will need to be drilled in order to secure the turbine. These holes should be drilled 10 mm & 25 mm from the top of the tower / mount bracket and should be perpendicular to the surface and skewed by 90 degrees. The holes should penetrate both sides and cross the centre line of the tubular section - see Fig-10.

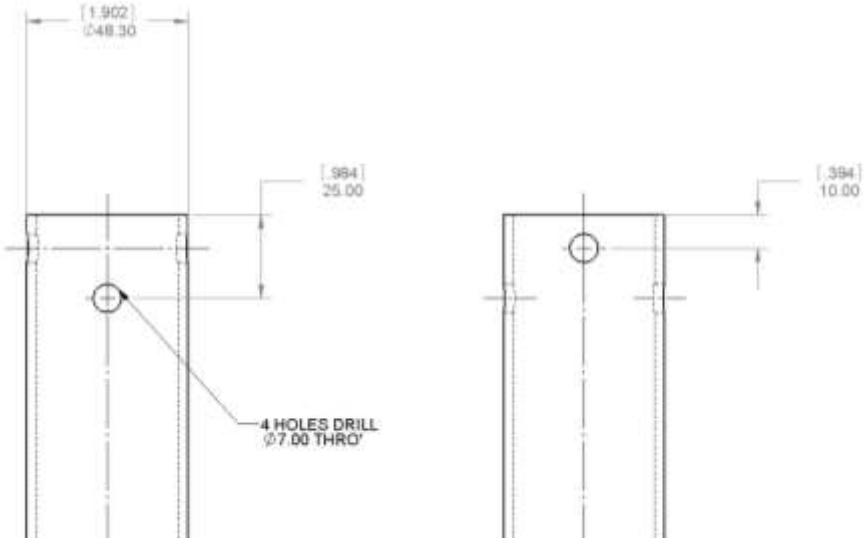

Fig-10: Drill through top of tower / mount bracket

9) *Install the Transmission Cables -* When your tower or mount bracket is ready to receive its turbine, the next stage is to run the cables from the top of the tower to where the electrical controller and batteries / grid-tie inverter will be located. Follow the table below to select the correct wire size (cross-sectional area). This will vary depending on your nominal battery voltage and the distance that the cables will be run. Careful selection of the cable size is required. It will not only affect the safety of the system, but also the overall efficiency. A cable of insufficient cable size will cause a voltage drop, wasting the power that has been generated. The cable sizes listed below have been selected with efficiency and cost in mind, as it is unlikely that your turbine will be running at full capacity 100% of the time. If in doubt, consult your local electrical supplier. The cable should be installed in accordance with local electrical regulations and guidelines. If in doubt, use a local electrical contractor to complete the cable installation.

Warning: If a cable of insufficient cross-sectional area is used, heat will build up in the cables causing a potential fire hazard. Cable capacities quoted below are based upon 'Tri-Rated' cables (BS6231).

	Transmission Distance		
***LE-300* Nominal Output Voltage**	10 Metres (30 Feet)	30 Metres (90 Feet)	100 Metres (300 Feet)
12 Volts	6 mm²	10 mm²	Not Recommended
24 Volts & Grid-tie	1.5 mm²	6 mm²	16 mm²

10) ***Mount the LE-300 Turbine onto the Support Structure -*** Ensure that the previously installed power transmission cables are not yet connected to any batteries and are 'shorted' together. This will prevent the turbine from operating during the installation process. Once this has been done, connect the turbine output cables to the transmission cables using a connecter supplied by Leading Edge Turbines (supplied separately) or a suitable terminal block with a minimum rating of 30 Amps. Offer the turbine up to the support structure and push the turbine body onto the tower. Ensure that no cables are snagged. Use the M6 x 65 set-screws along with two washers and an anti-vibration nut to secure the turbine using the holes previously drilled and the hole in the yaw pivot - see Fig-11. Ensure that M6 set-screws are securely fastened. Depending on the exact dimension of the tower, it may be necessary to use the supplied shim plate to ensure that the turbine is a snug fit upon the tower.

Fig-11: Fitting the turbine onto the support structure

Electrical Installation

Please refer to Figs 12 - 14 for appropriate generic wiring diagrams. In a battery charging renewable energy system there may be different ways of wiring small wind turbines, photovoltaic panels, charge controllers and batteries together. This type of system will often expand 'organically', but the following guidelines should be followed:

- ***Follow the appropriate electrical code -*** The electrical wiring of your *LE-300* turbine and associated electrical systems must be done in accordance with national and local electrical codes and regulations.

- ***Do not connect the turbine or batteries during the installation -*** Ensure that the turbine is not running or connected to the batteries during the installation or wiring process. Connect the output cables of the turbine together to prevent the rotor from starting up.

- ***Galvanic corrosion of electrical joints -*** Try to avoid connections between dissimilar metals. For example, connecting copper and aluminium together will result in galvanic corrosion of the connection. This will increase the electrical resistance of the connection (wasting energy), and reduce the mechanical integrity of the joint. Where possible, use a fluxed solder to make electrical joints.

- ***Protect the cables -*** The power transmission cables must be protected from mechanical damage and fatigue. Run the cables through an approved conduit / trunking.

- ***Cable strain relief -*** Prevent mechanical strain on the transmission cables running down the tower from the turbine. Clip the cables to the inside of the tower. Failure to do this will result in excessive mechanical strain on the cable joints within the slip-ring assembly and may cause a failure. Cable ties or cable glands are a good way to prevent mechanical strain on the cables.

- ***'Earth' the system -*** The turbine tower should have its own separate earth point. The negative terminal of the battery bank should also be earthed. This provides protection against the build-up of static and lightning strikes. The tower should be earthed separately with its own ground rod if there is a long transmission distance between the tower and batteries. An appropriate surge arrestor could also be used to help prevent damage to the battery charging system during a lightning strike. Ensure that the earth cables are of the same rating as the positive and negative cables.

- ***Cable Selection -*** The cable size table should be used to select the minimum sized cable for a given transmission distance. Voltage drop in the cable will be improved if a larger cable is used. We recommend using 'Tri-Rated' cable as it should comply with the wiring codes for your area.

- ***Fuses -*** The turbine and charging circuit should be protected with a suitably rated 'slow-blow' DC fuse or DC circuit breaker. Please refer to the table below for the correct rating. The fuse or breaker should be positioned between the turbine and batteries (on the positive cable). If a stop switch is used (recommended) the fuse should be positioned between the switch and the batteries.

LE-300 Nominal Output Voltage	***DC Fuse / DC Circuit Breaker Rating***
12V	25 Amp
24V & Grid-tie	13 Amp

- ***Run / Stop Switch -*** A simple switch arrangement can provide a safe and easy way of stopping the turbine during high winds, or for maintenance. *Leading Edge Turbines* can supply a switch which is best for this purpose. As the switch is thrown, the batteries are disconnected and the turbine is 'shorted' reducing the blades to a slow rotation. Refer to the generic wiring diagrams.

- ***Charge Controllers –*** For wind only battery charging systems (or where PV is added with an output of <30W) a DL-300 Diversion Charge Controller is recommended to manage the power output from the turbine to the batteries. This Diversion Charge Controller operates by increasingly switching output to a dump load once the batteries begin to reach high voltages. The dump load consumes the 'excess' power from the turbine. This means that the turbine's power output is always utilised whether the batteries are fully charged or not. Larger capacity battery banks will be able to store more energy and so the dump load will be used less. Do not use a photovoltaic type charge controller with your *LE-300* turbine.

  We recommend Tristar controllers for more complex hybrid wind/PV systems as this allows you to set the regulation voltage very accurately. This ensures that the Tristar can be configured to work with other charge controllers and prevents undesirable power dumping from other power sources such as PV.

- ***'Hybrid' Systems -*** The *LE-300* turbine can be used in parallel with PV panels. We recommend that the PV panels are wired independently with a separate charge controller specifically designed for use with them and connected in parallel with the battery bank - see Fig-13.

- ***Use of Grid-Tie Inverters -*** It is possible to connect your *LE-300* to a grid-tie (grid connect) inverter. It is recommended that only grid-tie inverters supplied by *Leading Edge Turbines* are used to ensure that an appropriate MPPT curve has been programmed.

- ***Installation on Yachts with shore power & engine alternator power sources-*** When installed on a sailboat, the *LE-300* may be required to work alongside shore power systems and engine alternators. In these cases, it is important to ensure that the DL-300 diversion charge controller (or similar) does not unintentionally 'dump' power from the shore power or engine alternator. This can be prevented by ensuring that the regulation set points on the shore power system and engine alternator are set below the regulation points of the DL-300 (or similar charge controller). This means that power from the shore power system and / or engine alternator will never be unintentionally 'dumped' through the dump load. If it is not possible to set the regulation points of the shore power / engine alternator below that of the DL-300 or similar charge controller, then the system should be wired in accordance with Fig 14 on Page 16 and the stop switch should be activated when the engine alternator or shore power system are in use. This will disconnect the diversion charge controller during use of shore power / engine alternator and will prevent unintentional dumping of power from these sources.

Please refer to the following wiring diagrams as a guide.

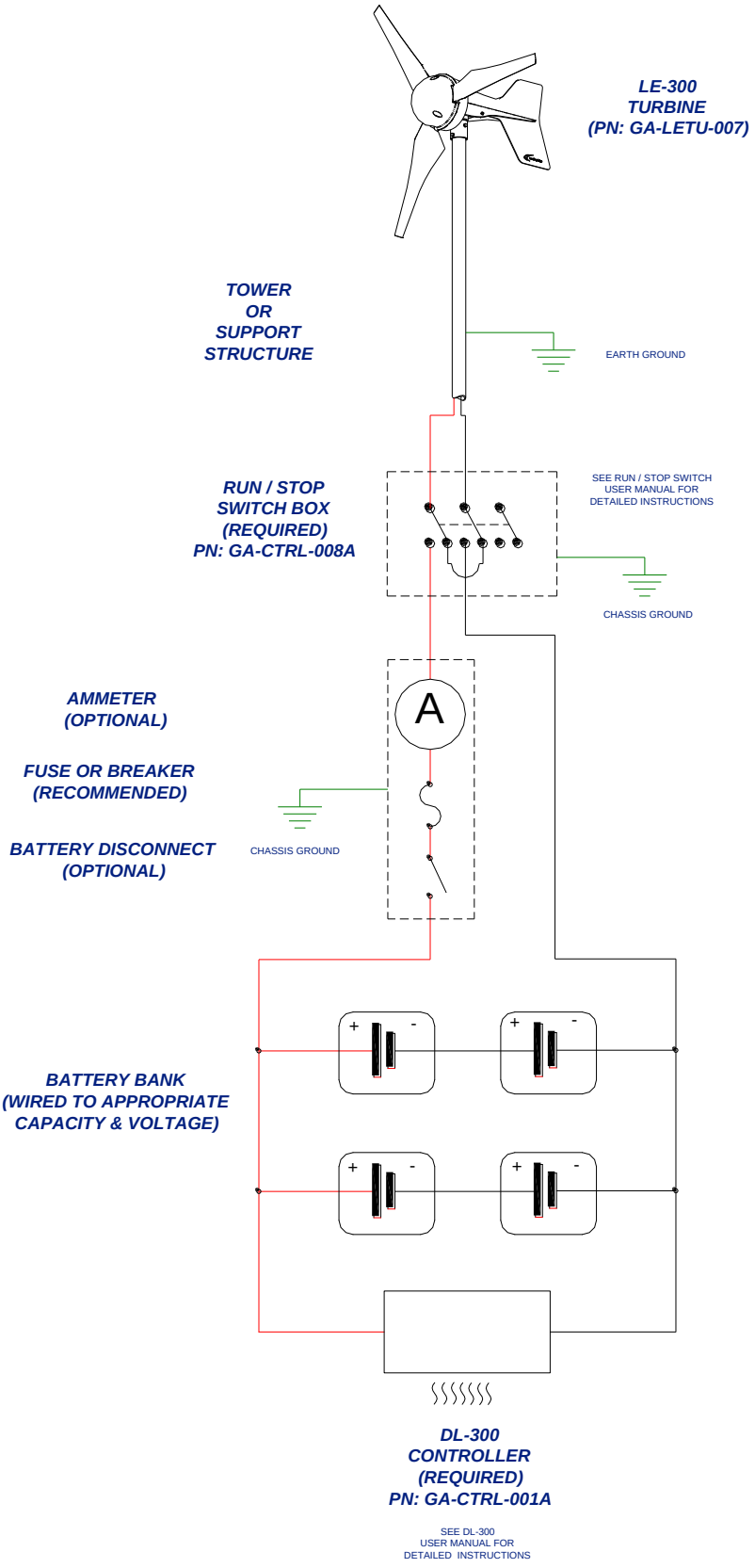

Fig-12: Simple 'Stand-Alone' battery-charging wiring diagram

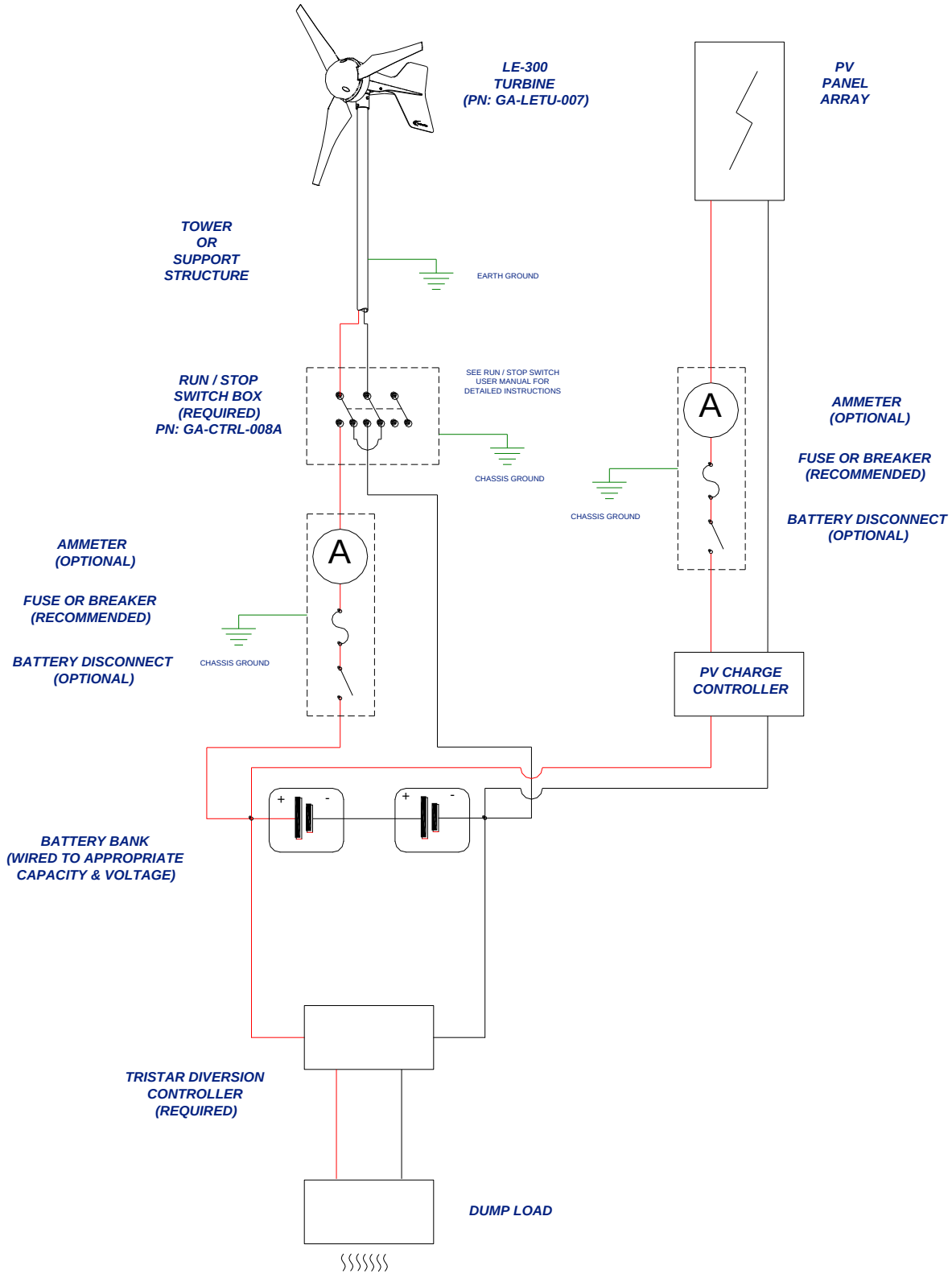

Fig-13: Typical 'Hybrid' wind /PV System wiring diagram

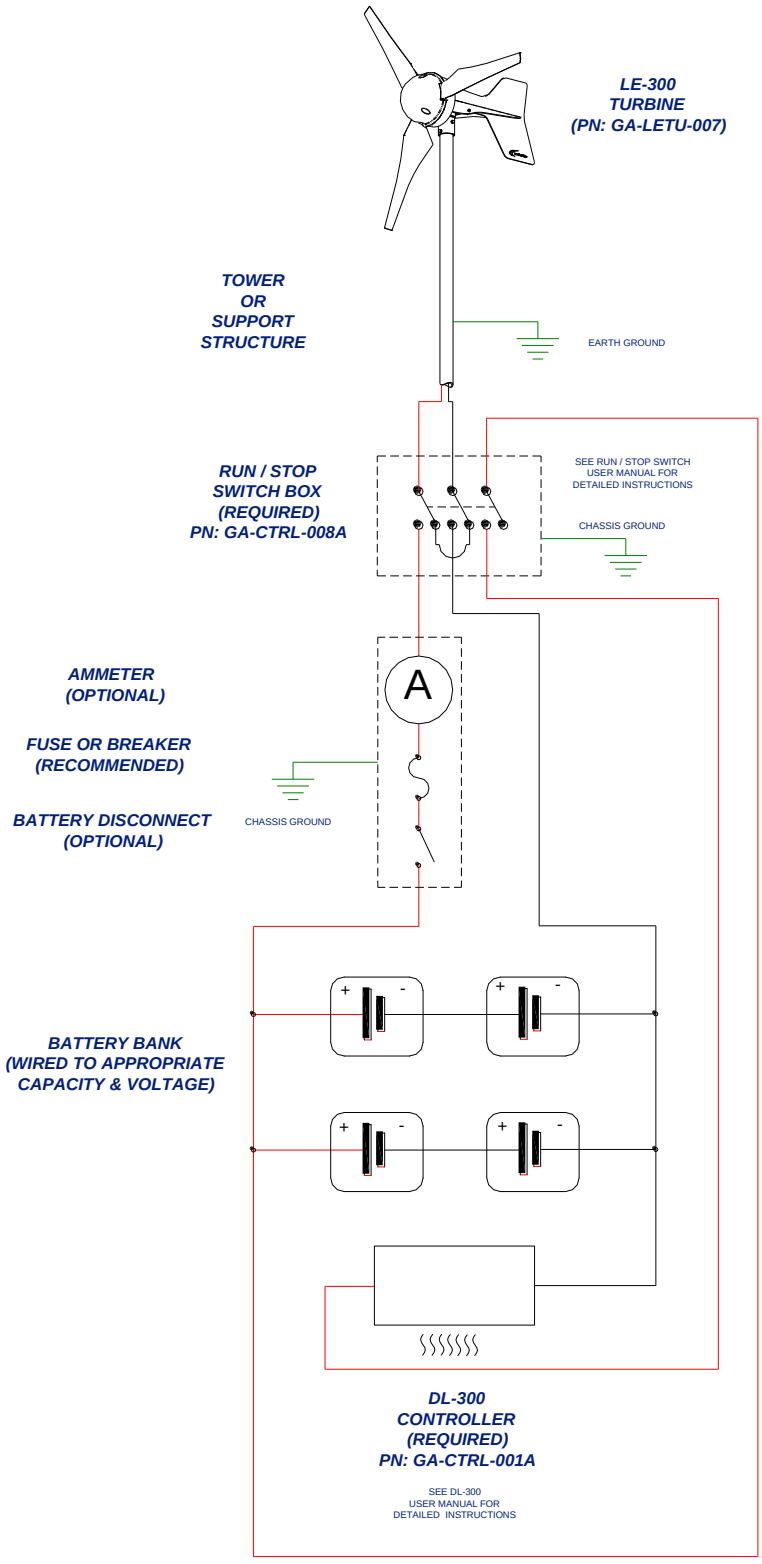

Fig-14: Typical 'Marine' system wiring diagram (DL-300 disconnects when the stop switch is activated – useful when the LE-300 turbine & DL-300 controller are to be used in conjunction with shore power and engine alternator power sources and the regulation points cannot be set lower than the DL-300 regulation points).

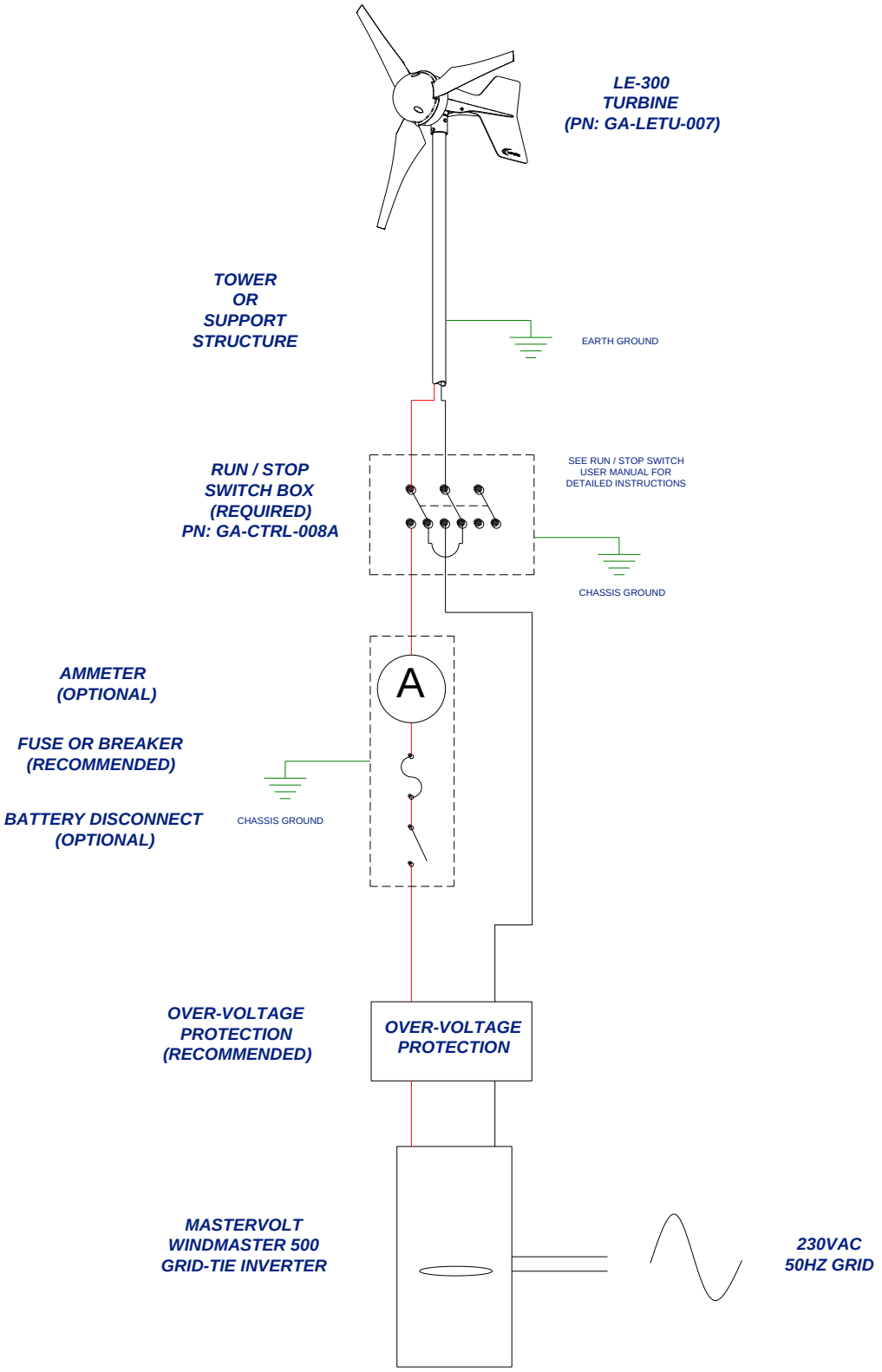

Fig-15: Typical 'Grid-Tie' system wiring diagram

Turbine Operation

The *LE-300* turbine is based on a simple design for ease of installation and reliable operation. You may notice the following behaviour during normal operation:

- ***Cut-in -*** The turbine will not begin to charge the batteries until the rotor is spinning at approximately 350 RPM. Whilst operating below this speed, the turbine will be 'off-load' and freewheeling. Once the turbine output voltage becomes equal to the nominal battery voltage (at around 350 RPM), the turbine will come 'on-load' and begin to deliver current to the batteries. During the off-load stages of rotation, the rotor blades rotate very freely. This allows the rotor to build up speed and allows aerodynamic lift to be generated by the blades.

- ***Normal Operation -*** Once the rotor is spinning at 350 RPM, current will be delivered to the batteries. As the rotor speed increases, so too will the current and voltage. Excessive wind speed may increase the battery voltage to a high level. Once this happens the diversion charge controller will recognise that the battery voltage is too high and begin 'dumping' power to the heater module.

- ***Charge Regulation -*** Once the charge controller has switched over to the dump load, the turbine will no longer be charging the batteries. Instead, the power from the turbine will be delivered to the dump load (usually a resistive heater element). The battery voltage will begin to drop to normal levels during the regulation period. Once the battery voltage is back within acceptable limits, the charge controller will switch the turbine output back to the batteries. Refer to the charge controller user manual for specific operational instructions.

- ***Shut Down -*** By activating the stop switch, the output from cables of the turbine are 'shorted' together. This effectively puts an infinite load on the generator causing the turbine to stall. When the stop switch is activated the turbine may still rotate slowly during high winds, but the rotor blades will not be able to build up any significant speed. It is not recommended that the stop switch is activated whilst the rotor is spinning at high speed. This sudden braking action will stress the blades and other components. Only activate the stop switch during a 'lull' when the rotor is not spinning excessively fast.

  Warning – Using the Run /Stop Switch in strong winds > 40 mph.
  In certain strong wind conditions the rotor can overpower the electromagnetic braking, which allows high currents to be produced in the stator coils. If this situation occurs for prolonged periods, damage to the turbine can occur. Therefore the Run / Stop switch should only be used to slow the unit prior to manually / mechanically tethering the turbine in very high winds. Either restrain the blades or swing the turbine to 90 degrees away from the wind and tether it in this position. A hole for tethering is provided in the tail-fin of the LE-300 (see Fig 16).

- ***Operation of the LE-300 in High Winds -*** Every effort has been taken to ensure that the *LE-300* will withstand the forces exerted by strong winds. However the raw power in high winds is immense and the stresses placed upon the turbine are magnified by gusty and turbulent conditions. Where possible the turbine should be shut down and tethered in advance of particularly strong, consistent winds (60+ mph) and storm conditions. This will decrease the wear and tear on the machine and will help to avoid a failure. Protect the turbine from extreme winds as you would protect other items of your property. ***Refer to the Shut Down procedure above.***

- ***Grid-tie Applications -*** When connected to a grid-tie inverter, the *LE-300* will operate in much the same manner as when it is charging batteries (except for the use of dump loads). It is important that the Grid-tie inverter characteristics are matched to the power curve of the turbine to ensure optimum performance. An appropriate electrical interface may also be required, depending on the inverter equipment being used. It is generally only recommended that *Leading Edge Turbines'* approved and programmed inverters be used with the *LE-300*. Refer to your *Leading Edge Turbines'* dealer for more information on this.

Note: Never allow the turbine to run off-load with no connection to a battery bank or grid-tie inverter. Doing so will allow open circuit voltages to be generated by the turbine. These voltages may be dangerous and may damage the stator coils within the turbine.

Fig-16: Tethering the rotor blades using the hole on the tail-fin

Maintenance

Please follow the preventive maintenance programme listed below. This will ensure that the turbine operates reliably and safely with good efficiency.

Always shut down the turbine before attempting to carry out maintenance.

Post-Installation Checks (to be carried out one month after installation):

- Check that the tower mount pins are secure and have not worked loose. Adjust if required.
- Ensure that the rotor hub is still securely fitted.
- Ensure that the rotor blades rotate freely.
- Monitor the output. Ensure that the turbine and charge controller are functioning correctly.

Annual Maintenance:

- Inspect the tower / support structure.
- Remove the turbine from its installation to a suitable workbench.
- Remove the rotor blade assembly.
- Inspect the edges of the rotor blades for damage such as dents or chips. The blades will become unbalanced if they are damaged. This will cause vibration, noise and poor performance. If many dents have occurred along the edges of the blades, a new set of rotor blades should be fitted (part numbers available in the Spares section).
- Inspect the roots of the blades (attachment tabs) for signs of stress cracking or fatigue. A new set of rotor blades should be fitted if any cracks of fractures have occurred (part numbers available in the Spares section).
- Remove any build-up of dirt and debris from the rotor blades using a mild detergent and warm water.
- Check the blade hub fixings for tightness.
- Carefully remove the yaw mount bracket by unscrewing the four connection screws from the sides of the *LE-300* chassis. Inspect the slip rings and wipers for obvious signs of wear. Replace the wipers if required (part numbers available in the Spares section). Reassemble the yaw pivot carefully (do not to pinch any cables).
- Check that all electrical connections are sound and free from corrosion.
- Generally ensure that the turbine is in good working condition and is safe for continued use.

After five years of normal operation:

- We recommend that the rotor bearings and rotor blades should be replaced after five years of continuous operation. This will ensure that the turbine's performance and safety is not compromised.

Other Considerations:

- The equipment used in the charging system (batteries, charge controller, PV panels, invertors, etc.) should be maintained according to the instructions published by the relevant manufacturer.
- Where lead-acid batteries are used, it is especially important that they are maintained carefully. Failure to do so will result in the batteries being rendered useless within a short period of time.

Spares

The following components may need to be replaced during the service life of your *LE-300* turbine. Please contact your nearest *Leading Edge Turbines'* Dealer, and quote the part numbers listed below.

Rotor Blade (set of 3)	DP-LETU-145 (X3)
Magnet Rotor	SA-LETU-015
Stator (12V / 24V / 48V)	SA-LETU-014A
Yaw pivot & Slip ring module	SA-LETU-016
Yaw Shim	DP-LETU-153
Nose cone	OS-115
Drive bearing (set of 2)	OS-090 (X2)
Rotor bearings and housing	DP-LETU-155
Run / Stop Switch Box:	GA-CTRL-008A
LE-DL-300 Diversion Controller:	GA-CTRL-001A

Warranty

Your *LE-300 turbine* carries a five-year warranty from the original purchase date, as supported by a retailer's receipt.

During the first two years of the warranty period any component found to be defective in material or workmanship will, at the discretion of *Leading Edge Turbines*, be replaced or repaired at no charge.

For the remaining three years of the warranty period, Leading Edge Turbines will supply 'non-consumable' parts at no cost. Leading Edge Turbines reserves the right to charge for fitting of parts supplied during this three year period.

In all cases, for minor component failures, replacements may be sent directly to the customer / dealer for replacement. For more serious defects we may suggest a 'return-to-base' arrangement for replacement or repair. In all cases *Leading Edge Turbines* will take reasonable action to ensure customer satisfaction. You will always receive a warm, courteous service in or out of your warranty period.

Your turbine must be installed and operated in accordance with this guide and local codes. Failure to do so will result in this warranty becoming null and void. Any unauthorised modifications to the turbine design will void the warranty and may compromise the safety of the machine.

What is not covered by your warranty?

- Damage caused by the neglect of periodic maintenance in the manner recommended.
- Damage caused by repair or maintenance performed using methods not specified by *Leading Edge Turbines* or by non-authorised dealers of *Leading Edge Turbines* products.
- Damaged caused by the use of non-genuine parts, or from the use of liquid agents or lubricants in or on the turbine, tower or control equipment.
- Damage caused by operating the turbine in conditions outside of those specified in the Owner's Guide – including, but not limited to, allowing the turbine to run off-load.
- Damage caused by modifications to the turbine, tower or control equipment not approved by *Leading Edge Turbines*.
- Damage caused to the turbine, tower and control equipment by improper storage or transport.
- Damage caused by lightning strikes.
- Damage due to extremely high winds and storm conditions (60 mph+).
- Damage caused by flying debris.
- Aesthetic phenomena that do not affect performance.
- Damage caused by unsatisfactory installation of the turbine, tower and/or control equipment.
- Damage caused by unsatisfactory tower / support structure design.
- Damage caused by incorrect connection to external electrical equipment, or failure to observe current regulations concerning connection to external electrical networks, equipment or any other devices.

If you should experience a problem with your turbine, your first 'port-of-call' should be the reseller or installer from whom you purchased the product. They will be able to resolve the problem quickly and efficiently. If you are unable to contact the original reseller, then please contact us directly. Please quote the serial number of your turbine when dealing with warranty issues. The serial number can be found on the nameplate positioned on the underside of the chassis.

Disclaimer

- All specifications are subject to change without prior notice.
- The information given in this user manual is believed to be accurate and reliable. *Leading Edge Turbines* assumes no responsibility for omissions or inaccuracies.
- The user of this information and product assumes full responsibility and risk.
- The *LE-300* turbine is a source of electrical power. It must be installed in accordance with local building and electrical regulations. Consult your local planning (zoning) office for details.
- The *LE-300* turbine has moving parts that may cause injury due to poor installation and unsafe operation. *Leading Edge Turbines* assumes no responsibility for problems caused by unsafe or unsatisfactory installation or operation.

Designed & Manufactured in the UK by:
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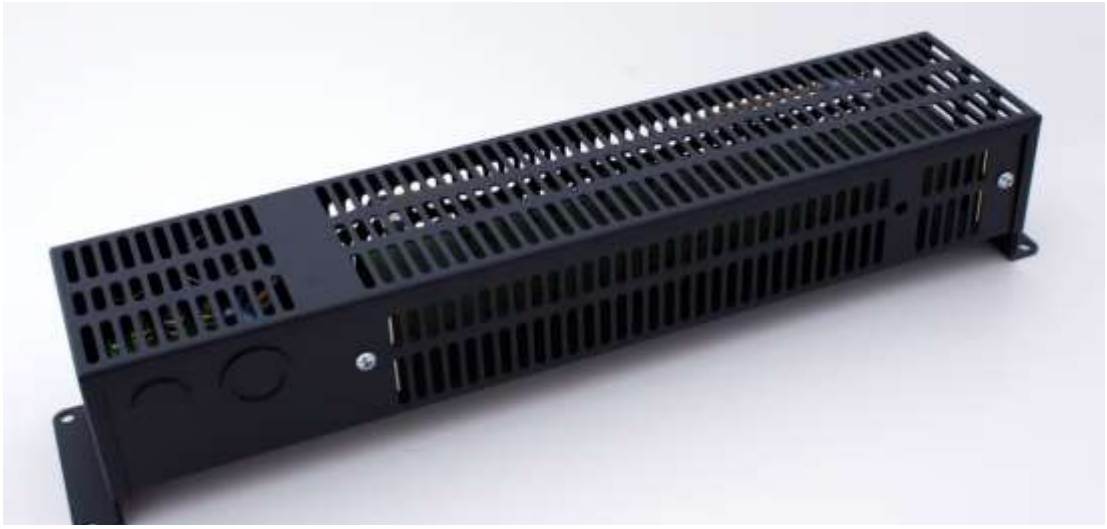
CE

Designed in accordance with
EN BS 61400-2: Safety of Small Wind

Appendix 1: DL-300 Charge Controller User Manual



Introduction

Please read this manual thoroughly before attempting to assemble, install or operate your DL-300 Charge Controller. This will assure optimum performance and safety.

The DL-300 Charge Controller and Dump Load is an integrated solution designed to prevent 12 or 24 Volt batteries from overcharging. It is designed to be used with small wind systems operating a *LE-300* turbine. Compact and easy to install, the DL-300 was developed especially for the *LE-300* turbine. It incorporates a 300 Watt resistor / heater and controller board in a stout powder coated steel enclosure.

Operation & Specification

The DL-300 dump load controller operates like an electrical overflow for your batteries. As the *LE-300* turbine charges the batteries, the State of Charge (SOC) and battery voltage will rise. As the batteries become fully charged and are no longer able to accept any further electrical energy, the battery voltage will rise. At this point, the dump load controller begins to bleed power into the dump load. This energy is then dissipated as heat into the surrounding environment. More or less power is diverted to the dump load according to how much is being supplied to the battery from the turbine.

The DL-300 Features:
PWM (Pulse Width Modulation) for highest charging performance without flicker
Selectable three stage charging or over-voltage protection mode
Selectable for sealed or flooded batteries using jumpers

Power, 12 Volt version, DL-300-12:
Recommend fuse or circuit breaker: 30 Amps
Integrated load resistor: 300 Watt, wire wound
Quiescent current when not load dumping: 2.6mA @ 12 Volts

Power, 24 Volt version, DL-300-24:
Recommend fuse or circuit breaker: 15 Amps
Integrated load resistor: 300 Watt, wire wound
Quiescent current when not load dumping: 3.0mA @ 24 Volts

Connections:
#10-32 brass screws for V+ and V-
Two 1/2” / 3/4” concentric NPT knockouts and two 1/2” NPT knockouts

Mounting:
Mounts to vertical concrete, metal, drywall, or other non-flammable surface
Uses four #10 screws
Body sits 19 mm out from wall
Enclosure suitable for indoor mounting

Weight and Dimensions:
Dimensions: 88 mm wide, 95 mm tall, 470 mm long (3.375 x 3.75 x 18.5 in)
Weight: 1.94 Kg (4.28 pounds)
Shipping Dimensions: 102 mm wide, 108 mm high, 508 mm long (4.0 x 4.25 x 20 in)
Shipping Weight: 2.15 Kg (4.75 pounds)

Materials:
Enclosure: 18 gauge mild steel, powder coated black
Circuit board: FR-4, 1.6 mm (0.062 in), double sided, plated through holes, solder mask, silk screen, gold plating.

Safety Precautions

Safety must always be your primary concern during the assembly, installation and operation of your *LE-300* turbine and DL-300 charge controller. Always be aware of the risks involved with mechanical and electrical installation work. If in doubt about any issue regarding your turbine system, please seek further assistance before proceeding.

Mechanical Safety Hazards:
Whilst installing the DL-300 charge controller or when performing routine inspection or maintenance, always stop the turbine by activating the stop switch.

Electrical Safety Hazards:
The *LE-300* generates rectified DC voltage and the DL-300 controller also operates at these voltages. Even at these low voltages there are inherent risks. Caution should always be used when connecting an *LE-300* turbine or DL-300 controller to the electrical system.

Ensure that you have followed the cable-sizing guidelines to ensure that the correct size of cable has been selected. If a cable of insufficient cross-sectional area is used at any point in the electrical system, heat will build up in the cables causing a potential fire hazard. A properly-sized fuse or circuit breaker should be used in the cables connected to the battery. This will stop the risk of short circuit currents.

Batteries used in renewable energy systems can deliver a serious amount of current. A short circuit in the battery circuit can lead to hundreds of Amps flowing through the battery cables. This will cause a heat build-up and ultimately an electrical fire. Batteries are also susceptible to explode when shorted. Always use insulated electrical tools when working on the battery's electrical connections.

Batteries are very heavy. Do not attempt to move batteries by yourself. Always use manual handling tools and an assistant.

Always keep lead-acid batteries the correct way up. Do not allow the acidic electrolyte to spill or come into contact with your skin. Always follow the manufacturer's safety instructions when handling lead-acid batteries.

Please use common sense when installing and operating your turbine and DL-300 Charge Controller.

Electrical Installation

Please refer to electrical schematic for appropriate generic wiring diagrams. In a battery charging renewable energy system, there may be different ways of wiring small wind turbines, photovoltaic panels, charge controllers and batteries together. This type of system will often expand 'organically', but the following guidelines should be followed:

Location – The DL-300 controller should be mounted in an adequately ventilated area, which is not exposed to direct moisture or spray. The dump load elements become hot during normal operation and should not be covered or blocked.

Gel or Flooded Batteries – An electrical jumper needs to be configured in order to make the controller more suitable for use with 'Flooded' or 'Gel' batteries. A jumper (supplied) should be applied to pins labelled '2.2' when the DL-300 is to be used with flooded batteries. When the DL-300 is to be used with Gel batteries, no jumper should be applied to pins '2.2'. **In any circumstance, no jumper should be applied to pins '2.1'.** Please see overleaf for Jumper positions.

	Jumper Pins 2.1	**Jumper Pins 2.2**
Gel type Batteries	No Jumper	No Jumper
Flooded type Batteries	No Jumper	Connect Jumper

Use the correct voltage controller – A 12V DL300 controller should only be used on a 12V battery system. A 24V DL300 controller should only be used on a 24V battery system. Do not interchange.

Follow the appropriate electrical code - The electrical wiring of your *LE-300* turbine and associated electrical systems must be done in accordance with national and local electrical codes and regulations.

Do not connect the turbine or batteries during the installation - Ensure that the turbine is not running or connected to the batteries during the installation or wiring process. Connect the output cables of the turbine together to prevent the rotor from starting up.

Galvanic corrosion of electrical joints - Try to avoid connections between dissimilar metals. For example, connecting copper and aluminium together will result in galvanic corrosion of the connection. This will increase the electrical resistance of the connection (wasting energy), and reduce the mechanical integrity of the joint. Where possible, use a fluxed solder to make electrical joints.

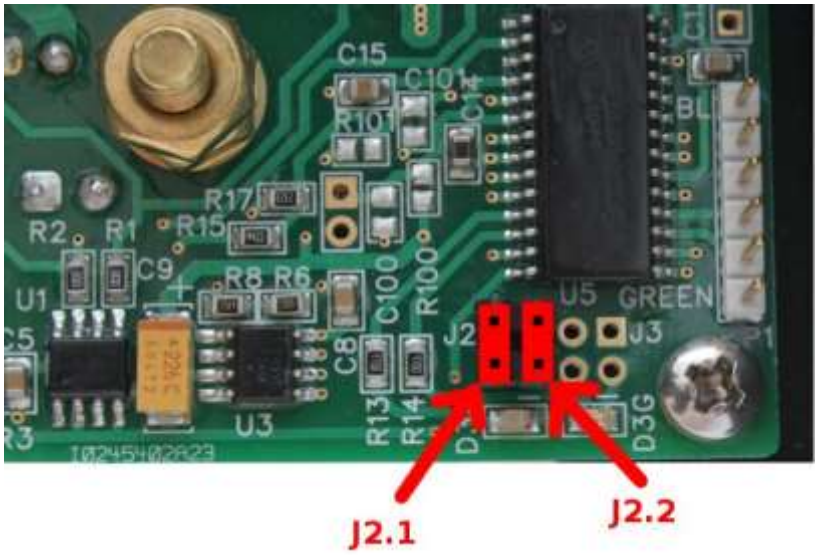
Protect the cables - The power transmission cables must be protected from mechanical damage and fatigue. Run the cables through an approved conduit / trunking.

Cable strain relief - Prevent mechanical strain on all cables. Cable ties or cable glands are a good way to prevent mechanical strain on the cables.

Fuses - The DL-300 controller should be protected with a suitably rated 'slow-blow' DC fuse or DC circuit breaker. Please refer to the table below for the correct rating. The fuse or breaker should be positioned between the DL-300 and batteries (on the positive cable)

Nominal Voltage	**DC Fuse / DC Circuit Breaker Rating**
12V	30 Amp
24V	15 Amp

Electrical Connections of DL-300 Controller



DL-300 Voltage Set Points

Whilst operating, the DL-300 does a multi-stage charge based on time and the bulk and float voltages:

12V Set points		
Mode	Flooded	Sealed
Bulk	14.6	14.3
Float	13.4	13.4
Protect	16.0	15.0

24V Set points		
Mode	Flooded	Sealed
Bulk	29.2	28.6
Float	26.8	26.8
Protect	32.0	30.0

LED Indicators

- Power Up (when the unit is switched on):
  - both LEDs ‘cycle’ during a self-test period

- Charging Mode:
  - ***Bulk Charge***: green LED on continuous
  - ***Absorption Charge***: green LED blink (12hz)
  - ***Float Charge***: green LED slow flash (6hz)
  - ***Dumping Excess***: red LED continuous when dump load active

Appendix 2: Run / Stop Switch User Manual

Introduction

Please read this manual thoroughly before attempting to assemble, install or operate your Universal Run / Stop Switch. This will assure optimum performance and safety.

The Universal Run / Stop Switch is designed to allow the user to dynamically brake an *LE-300* turbine at will. This is achieved by disconnecting the power output of the turbine from the relevant load and diverting it to a short circuit which then applies the dynamic braking effect on the permanent magnet alternator of the turbine. This will bring the turbine to a near stop for maintenance or to allow the turbine to ride out high winds and storms safely.

The Universal Run / Stop Switch can be used with turbines of different manufacture as long as the relevant turbine has the following characteristics:

3-Phase Wild AC not exceeding 500 V & 16 A
Wild DC not exceeding 150 V & 10 A
Mechanically and electrically capable of dynamic braking

Operation & Specification

The Universal Run / Stop Switch should ideally be operated during low speeds as repeated use at high speeds may cause damage if the turbine head (it was not designed to withstand repeated dynamic braking operations).

The switch has two positions:

Position 1: Turbine 'Stop' position. The turbine is dynamically braked and may be seen to rotate very slowly.

Position 2: Turbine 'Run' position. The turbine output is allowed to flow straight through the switch to the relevant output.

Safety Precautions

Safety must always be your primary concern during the assembly, installation and operation of your turbine and other associated equipment. Always be aware of the risks involved with mechanical and electrical installation work. If in doubt about any issue regarding your turbine system, please seek further assistance before proceeding.

Mechanical Safety Hazards:
Whilst installing the Universal Run / Stop Switch, ensure that the turbine is suitably restrained and not allowed to operate during the installation.

Electrical Safety Hazards:
The *LE-300* generates rectified DC voltage and the Universal Run / Stop Switch also operates at these voltages. Even at these low voltages there are inherent risks. Caution should always be used when connecting the *LE-300* or other equipment to the electrical system.

Ensure that you have followed the cable-sizing guidelines to ensure that the correct size of cable has been selected. If a cable of insufficient cross-sectional area is used at any point in the electrical system, heat will build up in the cables causing a potential fire hazard. A properly-sized fuse or circuit breaker should be used in the cables connected to the battery. This will stop the risk of short circuit currents.

Batteries used in renewable energy systems can deliver a serious amount of current. A short circuit in the battery circuit can lead to hundreds of Amps flowing through the battery cables. This will cause a heat build-up and ultimately an electrical fire. Batteries are also susceptible to exploding when shorted. Always use insulated electrical tools when working on the battery's electrical connections.

Batteries are very heavy. Do not attempt to move batteries by yourself. Always use manual handling tools and an assistant. Always keep lead-acid batteries the correct way up. Do not allow the acidic electrolyte to spill or come into contact with your skin. Always follow the manufacturer's safety instructions when handling lead-acid batteries. Ensure that the Universal Run / Stop switch is correctly wired as per these instructions and wiring schematics. Incorrect wiring may lead to a short circuit being placed across the batteries which can lead to fire or explosion.

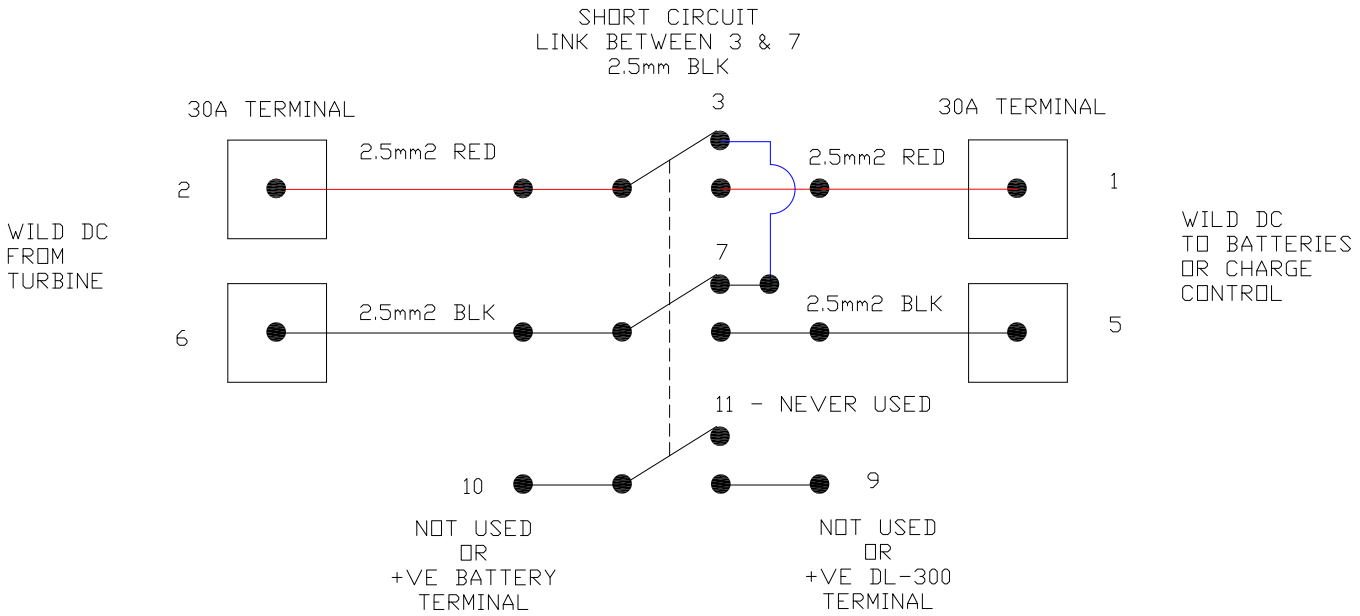
Please use common sense when installing and operating your turbine and associated equipment.

Installation

Please refer to electrical schematic for appropriate generic wiring diagrams.

The Universal Run / Stop Switch can either be mounted in the enclosure box (supplied), which in turn can be mounted on an internal panel, or the switch can be integrated into an existing panel.
If the unit is to be integrated into an existing panel, a suitable cut-out, as detailed on the wiring diagram will need to be made.

Switch Wiring for LE-300 Turbine:



Appendix 3: System Trouble-Shooting

Introduction

Small wind turbines are a complex mixture of mechanical, aerodynamic, electrical, electronic and civil engineering. Even with the most careful installation, it is possible that problems may occur during the installation or at some point during the life of the turbine.

The following headings are designed to help the installation engineer or turbine user to identify and resolve any issues with the system as a whole. Before referring to the trouble-shooting guide, ensure that the turbine has been correctly installed as per the instructions described earlier in this user manual.

Common Problems pertaining to Installation

Issue:
The turbine spins extremely quickly and noisily but doesn't deliver any electrical current to the batteries.

Potential Causes:

- The turbine may be running in an off-load state meaning that the circuit from the turbine to the batteries is not complete. In this situation, the turbine is free spinning and the turbine may be generating higher voltages than anticipated from the turbine output cables. Check that all of the connections from the turbine, through the run / stop switch to the batteries are correct. If a fuse or circuit breaker has been fitted to the turbine, ensure that this is correctly closing the circuit. Never leave the turbine running in an off-load state as it may cause damage to the turbine during high winds.

- The turbine may have developed an internal wiring fault which has resulted in a broken circuit. In this situation, the turbine is free spinning but no voltage will be measureable at the turbine output cables. If an internal fault is present, please contact your dealer or Leading Edge Turbines for further advice.

Issue:
The rotor hub plate fixings do not correctly grip the rotor hub plate which means that the rotor hub plate can rattle slightly.

Potential Causes:

- The rotor hub fixings have been positioned incorrectly in the drive bearing hub. Remove the fixings and replace them in the next hole over. This should allow the fixings to be completely tightened meaning that the rotor hub plate will be correctly installed.

Issue:
A slight oscillation can be observed in the turbine tail fin whilst the turbine is rotating at certain speeds.

Potential Causes:

- Due to the nature of small wind turbines, a small level of oscillation is acceptable as the turbine passes through certain speeds. This oscillation movement can be minimised by ensuring that the distance between each tip is within tolerance (please see step 4, page 8). Ensure, also, that the assembled rotor is correctly and concentrically fitted to the drive bearing housing.

Issue:
The turbine frequently comes to rest in the same horizontal position, regardless of which direction the wind is coming from.

Potential Causes:

- Turbines require that their towers are vertical. Although the *LE-300* is fitted with counterweights to compensate for the pitching and rolling of a yacht, it is still recommended in all applications that the turbine tower is set to be perfectly vertical. The *LE-300* is designed to be slightly tail heavy so that when it is fitted to a yacht that is healing in the wind, the turbine will favour the windward side.

Issue:
The turbine never seems to reach its operating speed and does not give any or very little power output.

Potential Causes:

- You may have installed a 24v turbine on a 12v battery system. This means that the turbine will reach its cut-in RPM prematurely and this in turn will stall the blades. Ensure that you have the correct voltage turbine for your application.

Issue:
A slight oscillation can be observed in the turbine tail fin whilst the turbine is rotating at certain speeds.

Potential Causes:

- Due to the nature of small wind turbines, a small level of oscillation is acceptable as the turbine passes through certain speeds. This oscillation movement can be minimised by ensuring that the distance between each tip is within tolerance (please see step 4, page 8). Ensure, also, that the assembled rotor is correctly and concentrically fitted to the drive bearing housing.

Issue:
When fitted to a yacht, vibration is transmitted through to the hull of the vessel.

Potential Causes:

- Small wind turbines are electro-mechanical devices and as a result a small amount of 'hum' can be present during the operation of the *LE-300*. Depending on the type and method of mounting to a yacht, some of the natural hum of the turbine alternator can be transmitted to the hull of the vessel. In order to limit or avoid this vibration transmission, it is recommended that appropriate anti-vibration mountings and bushes are used upon the structure used to support the turbine.

Common Problems pertaining to low turbine output

Issue:

- The turbine seems to be operating correctly, but the electrical output appears to be low. There are many reasons why the turbine may be demonstrating outputs that are lower than anticipated. These reasons can stem from turbulence, erroneous measurements through to battery type and condition.

Potential Causes:

- Turbulence is the most common reason why turbines do not perform to their specification. Turbines require clean un-turbulent laminar air flows in order to operate at their peak performances. This means that turbines need to be carefully sited in order to avoid areas of turbulence - unfortunately this is not always possible and compromises need to be made. Please see Appendix 4 for information about siting your turbine for best performance. Turbulence created by trees, structures and general topography will all create eddy currents in the wind which will severely reduce the turbine's efficiency. Generally, the turbine should be positioned on a tower as high as possible above any local features of the topography.

- Ensure that the correct minimum and maximum cable sizes have been installed (see section 9, page 11 of this user manual). Using a cable that is too small may lead to volt-drop losses, especially on a 12v system. Alternatively, using a cable that is large than the recommended size may lead to the turbine becoming stalled or semi-stalled which will impair performance.

- During operation the turbine alternator will become warm and even hot, especially during high wind events. When this happens, the resistance in the alternator coils dramatically increases which causes the alternator efficiency to drop drastically. This effects the overall output of the turbine. Performance will drop after the turbine has heated up due to prolonged high end running.

- Different battery technologies have different rates at which they can absorb power from a wind turbine. The batteries will draw all of the power possible from a wind turbine until they reach their absorption limit. Generally, more battery capacity can be added to increase the rate at which they can absorb power. Battery age and condition will also affect the rate at which the batteries can absorb power - older batteries or those in a poor condition will not draw the same power levels from the turbine as newer batteries in good condition.

- Poor state of your batteries caused by sulphation. If your batteries routinely rest at less than 12.5V it is likely that your batteries are in poor condition and unable to draw full power from the turbine. When the turbine is operating at 100watts, this will equate to 8.7amps whilst the batteries are at 11.5 volts, but the same 100watts only equates to 6.66watts when the batteries are at 15 volts. When using a current measuring device such as an ammeter, the current reading must be qualified against the voltage reading in order to calculate an accurate power output.

- Measurement errors can easily occur whilst measuring both the wind and power output of the turbine. For example, in marine applications the wind speed measurement is often made at the top of the mast which will be approximately 10m + above the height of the wind turbine. The measured wind speeds at this height will be much higher than the wind speeds that the turbine experiences. This may lead to the assumption that the turbine is underperforming in any given wind speed. Furthermore, current shunts are often used in low voltage DC systems due to the amount of currents flowing. Ensure that high quality shunts are employed for accurate current readings.

Appendix 4: Turbine Site Selection

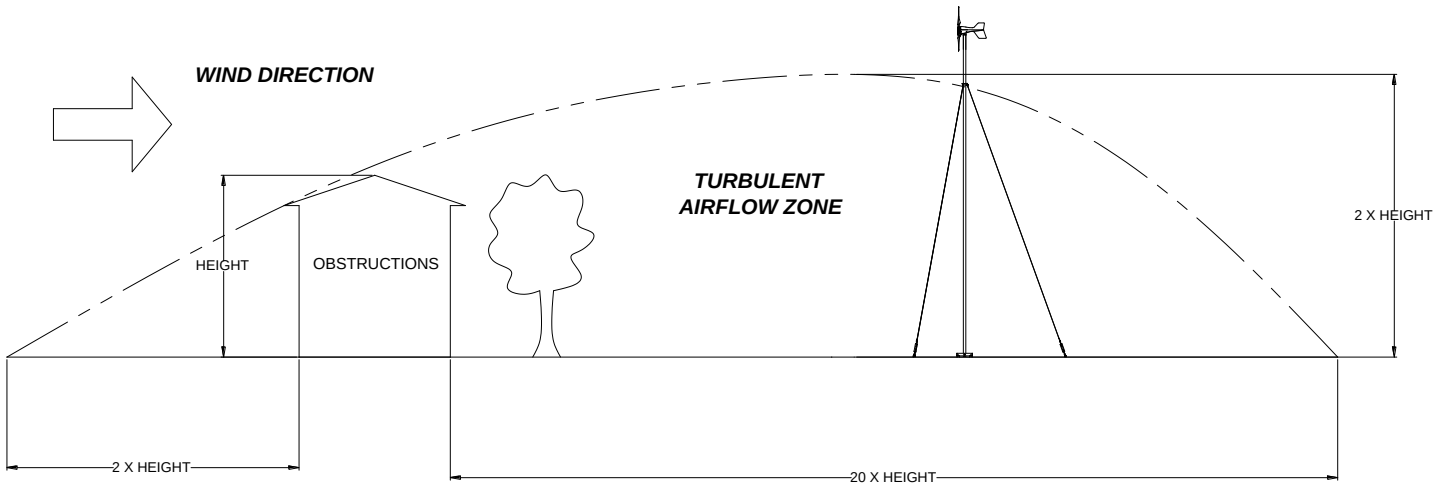
Turbine Site Selection

The turbine location is a very important factor in the overall performance of your small wind turbine system. Good site selection will maximise the power that your turbine will be able to deliver. Installing a wind turbine in a bad position is similar to installing a solar panel system in the shade – it will not maximise the performance of your investment.

The total amount of energy available in the wind increases drastically with small increases in wind speed. Therefore it is very important that you site your turbine in the best possible location.

The proposed installation site for your wind turbine must have a good average wind speed of a minimum of 4.0m/s (9mph) and low wind turbulence. Wind turbulence is caused by obstructions to the wind such as trees and buildings. Excessive turbulence will hamper the performance of your turbine. Small wind turbines operate best in steady airflows. Free flowing airstreams are more consistent in direction and wind speed which results in more overall power being generated by the wind turbine system. Gusty conditions often result in a turbine 'hunting' the wind reducing the amount of overall power generated. Gusty and turbulent conditions also exert fluctuating forces upon the turbine that can reduce the reliability and lifespan of the system.

Wind shadowing and barriers: Wind barriers are simply obstacles that impede the flow of the wind (such as trees and buildings). A large 'wake' of turbulent airflow will occur for a long distance downwind of a barrier. It is not desirable to locate a turbine in this zone.



Topography: For areas of undulating ground, the turbine should be installed in the highest possible position avoiding wind barriers and turbulence. For areas that are generally flat, the turbine can be installed in any position. Remember that the LE300 has a low voltage output, so it is important to keep the cable run to the batteries / inverter as short as possible.

Surface roughness of the ground: Long grass, crops or bushes will have the effect of slowing the wind down (even at the height of the tower). Try to install your turbine where the ground is smooth to increase the overall power production of the system.

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